Department of
Agriculture

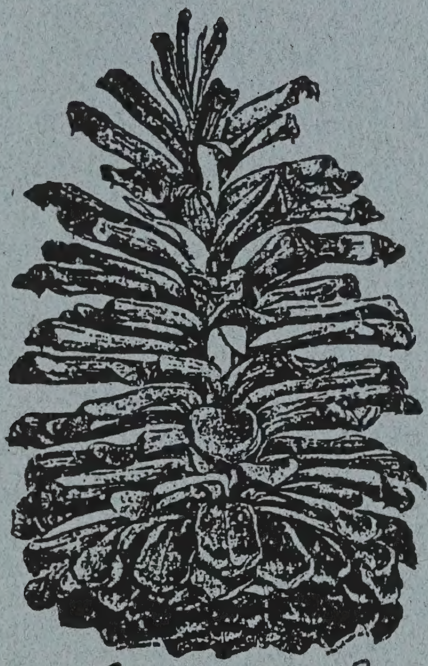
Forest Service

Forest Pest
Management

Davis, CA

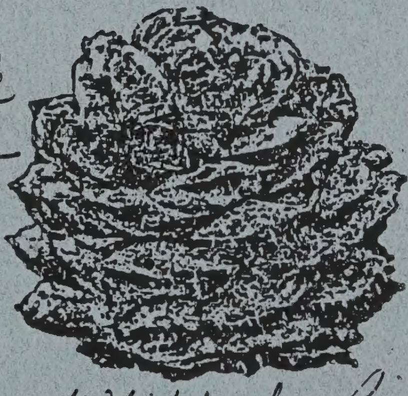
TACTICAL PLAN

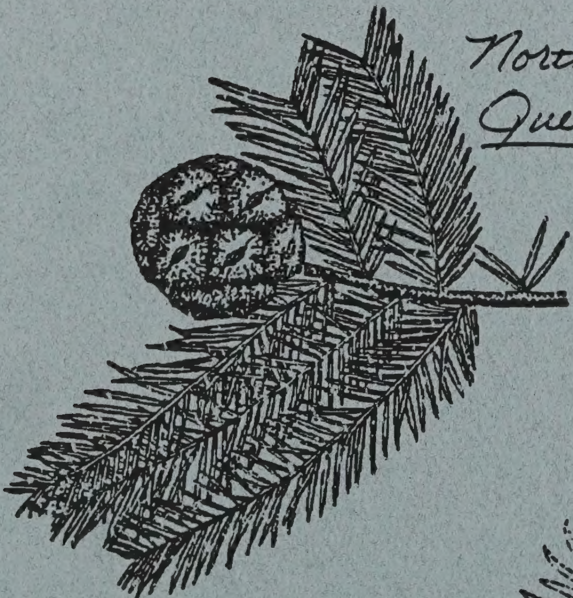
National Steering Committee for Management of Seed, Cone, and Regeneration Insects


Longleaf Pine
Pinus palustris


American Chestnut
Castanea dentata


Northern Red Oak
Quercus rubra


Whitebark Pine
Pinus albicaulis


Baldcypress
Taxodium
distichum


Western Larch
Larix occidentalis

FPM 94-6
January 1994
Updated September 1994

Pesticides used improperly can be injurious to human beings, animals, and plants. Follow the directions and heed all precautions on labels. Store pesticides in original containers under lock and key—out of the reach of children and animals—and away from food and feed.

Apply pesticides so that they do not endanger humans, livestock, crops, beneficial insects, fish, and wildlife. Do not apply pesticides where there is danger of drift when honey bees or other pollinating insects are visiting plants, or in ways that may contaminate water or leave illegal residues.

Avoid prolonged inhalation of pesticide sprays or dusts; wear protective clothing and equipment, if specified on the label.

If your hands become contaminated with a pesticide, do not eat or drink until you have washed. In case a pesticide is swallowed or gets in the eyes, follow the first aid treatment given on the label, and get prompt medical attention. If a pesticide is spilled on your skin or clothing, remove clothing immediately and wash skin thoroughly.

NOTE: Some States have restrictions on the use of certain pesticides. Check your State and local regulations. Also, because registrations of pesticides are under constant review by the U.S Environmental Protection Agency, consult your local forest pathologist, county agriculture agent, or State extension specialist to be sure the intended use is still registered.

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Tactical Plan

National Steering Committee for Management of Seed, Cone, and Regeneration Insects

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Preface

The 5-Year Tactical Plan for the National Steering Committee for Management of Seed, Cone, and Regeneration Insects has been prepared by the steering committee. **This is an update to the 1993 plan.** The plan serves as a basic planning reference to assist the committee in identifying USDA Forest Service, Forest Pest Management, Technology Development Program needs and needs of other cooperating organizations actively involved in research and management of seed, cone, and regeneration insects. Years are indicated by each action item; however the utility of specific calendar year designations are dependent upon Regions and NA submitting **proposals, and the Washington Office approving and funding the proposed projects. Bold type reflects 1994 update. At the 1994 committee meeting in Rhinelander, WI, the committee decided to embark on developing a strategic/tactical plan. Roger Sandquist, R-6, is chair of the sub-committee that will develop the strategic/tactical plan. The 5-Year Tactical Plan will serve the committee until the enhanced plan is developed.** Comments and suggestions are encouraged.

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I. INTRODUCTION

Purpose

The purpose of this 5-Year Tactical Plan (Plan) is to support the FPM Technology Development process by establishing a system of identifying seed, cone, and regeneration insect goals and actions that support Forest Pest Management's strategic direction and goals to protect the health of America's forests (1). The scope of the Plan is primarily limited to managing seed, cone, and regeneration insects and the FPM Technology Development Program. Basic research, however, cannot be separated and for this reason research, being essential to accomplishing the goals, is included. In this context the Plan becomes a rationale, logical, and sequential system to achieve stated goals. It provides management a roadmap and an instrument to monitor progress. **While the Plan is primarily in support of the FPM Technology Development Program we hope it will also assist managers in allocations of funds other than the Technology Development source of funds. It is through cooperation and integration of program objectives that we can progress in this important work area.**

Background

The evolution of the FPM Technology Development Program is one of continued effort to improve its process, efficiency, productivity, and accountability. Prior to establishing national steering committees in 1988, the process of managing the technology development, or special projects, was generally undefined, focused on the near-term, lacked some accountability, and was not tied to strategic goals. Given these shortcomings the program was, nevertheless, productive but most recognized need for improvement. Since 1988 the FPM Technology Development Program has been improved to address shortcomings, new needs, and opportunities. Suggestions and support from field units, the FPM National Steering Committees, and availability of a WO Staff Scientist to manage the Program have contributed to an improved and effective FPM Technology Development Program.

The National Steering Committee for Managing Seed, Cone, and Regeneration Insects and the other FPM National Steering Committees, were asked in 1993 by the Director, FPM to prepare 5-Year Tactical Plans. The plans are to specify short-term needs achievable within a 5-year target. Needs identified in the plans are to be high priority and consistent with strategic forest health planning.

At the 1993 Placerville meeting of this committee we identified 20 needs (2). Of these 20, 7 were identified as high priority. They were ranked again by vote, and the 7 needs were then stated as goals and listed herein by order of priority. **At the 1994 Rhinelander meeting the committee reaffirmed its commitment to the first 6 goals, dropping the Goal 7.**

Program Categories

This committee identified 6 administrative program categories that cover all proposed activities within the 5-Year Tactical Plan. If the need does not fit one of these categories, it is likely beyond the scope of this committee and its plan. The categories are:

- Basic biological and taxonomical information
- Impact
- Monitoring
- IPM situation/decision models
- Control strategies
- Technology transfer and training

Within these categories, activities would include basic research, applied research, development, demonstrations, operations, and technology transfer. FPM cannot, by law, use funds to support basic research, but are encouraged to coordinate needs with researchers and form partnerships to address research needs that affect tactical planning goals.

Format of Plan

We have chosen a format that does not include a vision or mission statement to be consistent with the Chief's direction of one Forest Service vision and mission statement. Each Goal statement is followed by a Rationale that clarifies and expands upon the goal statement, explains why this goal is important, and briefly discusses how it relates to forest health and ecosystems management. This is followed by Actions to accomplish the goal. In case there is need for sub-actions, we can refer to these as Strategies in future updates of the Plan. Each Action and Strategy will be assigned a date for completion with a 5-year to 7-year span as the Plan is expanded. Specific years have been assigned to some of the goals while others are assigned by Phase and/or Year-1 as an example. Initiation of action items under some goals is dependent, as an example, upon insect populations; therefore proposal funding decisions should factor-in windows of opportunity.

II. 5-YEAR TACTICAL PLAN

Goal 1 - White Bark Pine

Regeneration insects of white bark pine have been identified, monitoring and impact assessment methods developed, and potential control strategies have been identified.

Rationale

Only recently has white bark pine, Pinus albicaulis, been recognized as a key component of high elevation ecosystems throughout much of the West. This unique species plays an important role in the survival and distribution of such wildlife species as the grizzly bear and the Clarks nutcracker, by providing a high protein food source with its cones and seeds. Research has recently documented the rapid decline of this important species in western Montana and other areas (Keane and Arno, 1993) due primarily to the introduced white pine blister rust fungus and periodic outbreaks of the mountain pine beetle. A need is being recognized to promote natural regeneration and to supplement it artificially, especially with rust resistant nursery stock.

To date virtually nothing is known about the role cone and seed feeding insects play on the regeneration of this species. Prior to developing treatments to protect cones and seeds from insect depredations, it has to be determined what insect complex is affecting seed production, the extent of its impact, and whether protection is needed.

This technology development project would be a cooperative effort with R-1 FPM, R-1 Genetic Resource Program, and the PSW Station.

Actions

It is proposed that this goal be addressed in three phases with the initial phase beginning when there is a sufficient flower crop.

Phase 1

Years 1-3

Initial work to be done on this Goal will be to determine the insects that are significantly affecting white bark pine seed production, and the impacts they're having. This will be accomplished by locating cone

collection sites in representative stands and collecting cones to obtain insect specimens through cone dissections and rearing. Insects thus obtained will be sent to specialists for positive identification. The type and extent of damage caused by each pest will be measured. To ensure an accurate assessment, and to capture all important insects species involved, this phase of the project will continue for three years. Due to the sporadic cone production of most conifer species, these likely will not be three consecutive years. With this background information in hand the need for population monitoring and subsequent control tools can be assessed.

1994 work done with R-1 base funds.

Initial work has begun in Idaho and Montana in 1994. However, the 1994 cone crop is very poor. We have identified sites with sufficient second year cones for collections. Collections at these sites for cone dissection and rearing will occur in late August 1994. We will also identify sites this summer and fall that have first year conelets for 1995's collections. Regions 4, 5 and 6 will be contacted for possible cooperation.

Possibly some chemical exclusion work in 1995 by R-1 and PSW.

Committee encourage multi-regional cooperation on this work.

Phase 2

Year 4-5

Assuming the pest identification/impact assessment phase of this project verifies a need to control insects affecting white bark pine cone and seed production, effort will be directed towards identifying how to recognize when populations exist that, when left untreated, will cause intolerable impacts. Monitoring tools may include such approaches as pheromone baited traps, sample cone dissections, light traps, beating samples, etc.

Phase 3

Year 5-7

The final phase of this project will be the development of control approaches. Alternatives include the application of microbial and/or chemical insecticides, pheromones for mass trapping and/or mating disruption, and mechanical and/or cultural control approaches.

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Goal 2 - IPM for Seedbugs and Coneworms

Integrated Pest Management strategies for seedbugs and coneworms have been developed.

Rationale

Coneworms are considered to be the most potentially damaging insect species attacking yellow pine seed orchards. A pest management system is needed to tie together three decades of research and development concerning the survey, detection, evaluation, and control of coneworms. Development of an Integrated Pest Control System to minimize the impact of coneworm populations on pine seed orchards is now possible.

Seedbugs, Leptoglossus corculus and Tetyra bipunctata are the most underrated pest in southern pine seed orchard and an IPM system for reducing damage and pesticide usage is now possible following recent research results in Georgia.

Actions

The following steps will guide us in the development of this project:

1995	We will field test the seedbug degree day model that was recently developed by SEFES entomologists. We will develop the computer system to collect weather and coneworm pheromone trap catch data. We will develop the protocol to evaluate current pheromone trap catch data and compare this to historical data collected the past 13 years. We will field demonstrate meteorological equipment that is portable, user friendly, and reliable with low cost.
1996	Degree day models for 2 of the coneworm species will be integrated into the computer system in 1996 and the models will be field tested and validated. The computer system will be further developed to handle communications between orchard managers and project entomologists on key locations across the South. Additional insecticide tests may be needed to further develop the degree day model for seedbugs.
1997	The remaining 2 degree day models for the other coneworm species will be field tested and added to the computer based IPM system. Computer based warnings of impending pest outbreaks will be integrated into the data based allowing the analysis of pest

populations as they develop in the spring and summer. Seedbug treatment alerts should be possible following the successful 1995 and 1996 field seasons. These alerts would inform growers of the correct time to treat the most damaging second stage nymphs.

1998 The IPM system will be operational, collecting weather, pest population data, and communication meaningful information on potential pest threats, spray timing, and pest treatment recommendations to cooperating orchards. Additional evaluations and fine tuning of the models may be required.

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Goal 3 - Dioryctria Pheromone

Pheromones for Dioryctria spp. have been developed and are available for operational use.

Rationale

During the past 3 years entomologists with FPM and SEFES have attempted to disrupt mating and to reduce damage using pheromones of Dioryctria disclusa and D. merkeli. During the three year study we have successfully disrupted mating by shutting down baited pheromone traps in treatment blocks but because of small treatment block size we were not able to show damage reduction. We also were able to show disruption of live virgin females placed in the mating table in the treatment area in 1992. A very limited supply of females in 1991 and 1993 made it impossible to establish mating tables and to test mating disruption during these years using this method of evaluation. In the future we intend to further evaluate mating disruption using pheromones as an alternative to toxic insecticides such as Guthion. The following is the outline for further work in this area.

Actions

1995	Aerial application of Dioryctria disclusa pheromone in Hercon flakes will be attempted this year on an industrial loblolly pine seed orchard in the South during 1995. The flakes will be applied via aircraft using Gelva 1990 as a sticker. We will evaluate disruption on a large scale and the distribution of the flakes within a pine canopy. Additional work will determine the length of time the flakes adhere to pine foliage and the amount of water necessary to wash off the flakes. Approximately 225 acres will be treated.
1996	We will determine the damage to the loblolly crop from Dioryctria disclusa following treatment in 1995. The area will be retreated with D. disclusa pheromone.
1997	Evaluate pheromones for another coneworm species. For example research is planning on reevaluating the minor components of the D. amatella pheromone. If this work is successful in 1995-1996 we could test disruption on this important multi-voltine coneworm species. Reinventory D. disclusa damage and evaluate the success of the disruption project.
1998	Reapply D. amatella pheromone for second year testing.
1999	Reporting and technology transfer activities.

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Goal 4 - Western White Pine

Monitoring and control systems for western white pine seedbug and coneworm have been developed and are available for use. Basic taxonomic issues are settled and behavioral chemicals for western white pine seedbug, cone beetle and coneworm have been identified and are available for development into pest management tactics.

Rationale

Reforestation of forests with western white pine depends upon seed with known levels of blister rust resistance from seed orchards. In order to restore white pine in areas where its presence has diminished by mortality due to blister rust and to replace root disease susceptible species in root disease pockets with a more root disease tolerant species, western white pine seed is in great demand and growing with emphasis on ecosystem management. The major pests, which can practically eliminate the cone crop, are seedbugs and (locally) cone beetles and coneworms. Basic research must be conducted to support the development of pest management options.

Actions

Western Cone Beetle

Years 1 - 3	Identify the components and the structural and stereochemical identities of the useful components.
Year 4	Determine trap or releasor design and useful release rates.
Year 5	Conduct initial field trials of trap-out or repellent strategies.
Year 6	Evaluate and report results.

Seedbugs

Years 1 - 3	Identify the major marker pheromones.
Years 4 & 5	Conduct field trials to determine if marker pheromones are useful in monitoring for seedbugs.

Dioryctria

Years 1 - 3	Conduct taxonomic evaluations and life cycle/host plant relationship investigations.
Years 3 - 5	Continue investigations on identification of behavioral chemicals potentially useful for population monitoring or manipulation.

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Goal 5 - Single Tree Treatment

Single tree treatment methods to **reduce** seed and cone loss in wild stands **and orchards** have been developed and demonstrated.

Rationale

Several conifer species, such as sugar pine, western white pine, and Port-Orford-cedar, are seriously threatened by introduced diseases that have had drastic effects on our ability to reforest these indigenous conifers. In the future, managed seed orchards will meet our seed requirements for these species. However, we currently depend on collection of seed from disease-resistant trees in wild stands. These trees are usually remote from other Forest Service activities and are very tall, so it is difficult to treat them using conventional methods. Furthermore, the disease-resistant pines are attacked by a cone beetle, *Conophthorus ponderosae*, that probably cannot be controlled with implanted systemic insecticides. Aerial application of insecticides to such trees, in addition to being controversial, is prohibitively expensive in today's budget climate. Early tests of an arboreal sprinkler system (coupled with a truck-mounted spray tank) appear to have promise as an effective, inexpensive, and semi-permanent system for protecting valuable cone crops in remote sites. The cost for such arboreal sprinklers may be as low as $25 per tree.

Actions

1993 Develop and test a single-nozzle prototype of the arboreal sprinkler system in sugar pine.

In 1993 and 1994 single tree spray system was developed by MTDC and tested by MTDC, PSW, and Sierra NF.

System was installed in sugar pine to spray Asana to control seed and cone insects. System feasibility was demonstrated.

1994 Test a multiple-nozzle prototype and compare with single-nozzle system, using both seed yield and spray recovery as measures of treatment efficacy.

Single tree testing conducted in 1994 in Coeur d'Alene orchard by R-4 and MTDC.

1995	Continue study to obtain two years of efficacy data to increase statistical database.
1996	Compare the best arboreal system with an aerial (helicopter) application of the same insecticide.
1997	Technology transfer

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Goal 6 - *Dioryctria* Pheromone Douglas-fir

Effective pheromone detection systems for *Dioryctria* spp. in Douglas-fir have been demonstrated.

Rationale

The fir coneworm, *Dioryctria abietivorella* (Grote), has a wide host range in tree species as well as the issues attacked. The taxonomy of western *Dioryctria* spp. is in a state of confusion, and the pheromone that has been identified for *Dioryctria abietivorella*, a transcontinental species, does not reliably attract this species in the field. In fact, *D. abietivorella* as currently construed attacks a number of conifer species (Douglas-fir, true firs, and pines) and various tissues of those host species, including cones, buds, shoots, galls, wounds, and graft unions of Douglas-fir and other western conifers. Damage to cones of Douglas-fir and true firs can be severe in plantations and orchards. The development of an effective pheromone, and subsequently detection systems, is vital to the management of this insect in situations such as the Chico Tree Improvement Center. Accurate species characterization is absolutely essential for the development of pheromonally based insect control methods; mating disruption is a promising method for controlling *Dioryctria* spp., but both the insect species and their behavioral chemicals must be accurately identified. It has been suggested that *D. abietivorella* represents more than one species, but systematists have been unable to resolve this question with classical morphological methods. New methods based on pheromones and amplified DNA techniques, however, may provide quick and reliable species separation in this problematic group. The most effective research and development approach for dealing with this type of problem is to combine R&D on behavioral chemicals with development of quick genetic or biochemical assays for species identification. Such an approach is based on simultaneous sampling of pheromones, cuticular hydrocarbons, isozymes, and DNA (ribosomal or mitochondrial), so that clear links can be established between pheromones and taxonomic criteria at the same time that effective behavioral chemicals are identified and validated.

Actions

1994	Collect specimens of *D. abietivorella* and sample their cuticular hydrocarbons, pheromones, host volatiles, and mtDNA/rbDNA.
1995	Continue 1994 effort, and assay potential behavioral chemicals using laboratory olfactometers and electroantennograms.
1996	Field-test behavioral chemicals that were identified in laboratory assays, and develop optimum releasers and release rates for both monitoring (traps) and control (mating disruption releasers).

1997	Correlate pheromone trap catches with damage rates in seed orchards, and conduct preliminary field-test of mating disruption techniques.
1998	Conduct full-scale field test of mating disruption and validate monitoring and damage prediction using baited traps.

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3. Keane, Robert E. and Stephen F. Arno. 1993. Rapid decline of whitebark pine in western Montana: evidence from 20-year remeasurements. Western Journal of Applied Forestry, Vol.8, Number 2.